Light has always been recognized as one of the most powerful formgivers available to the designer, and great architects have always understood its importance as the principal medium which puts man in touch with his environment. In 1927, for instance, Le Corbusier stated that “Architecture is the masterly, correct and magnificent play of masses brought together in light.” Many others from the designers of the Parthenon and the craftsmen of the cathedrals to the masters of the Modern Movement have left us mute legacies of stone and steel and light which testify eloquently to their similar convictions (Figs. 1 and 2).

The years since Edison, however, have brought architects quite literally more light than they know what to do with. After centuries of painstakingly and often ingeniously manipulating our buildings to suit the vagaries of natural light, we find, paradoxically, that we have very little aptitude for manipulating our new wealth of artificial light to suit the vagaries of our buildings.

When all buildings were designed around a single, fixed light source—the sun—the difference between great architecture and mere building could be measured to a large degree by the skill with which that source was used. The shapes and sizes of rooms, and the materials and details in them, were determined largely by the appearance the room would take on when rendered by daylight. Light was not always simply applied to structural innovations; more often, the structures themselves were developed to make possible desired lighting and spatial effects.

Now, finally, we have artificial sources which are not only easier to control than daylight, but can also light interior spaces far more brightly. Theoretically, the possibilities for imaginative lighting are limitless. And, theoretically, our ability to create great architecture should have increased in proportion to the availability of more, and more versatile, artificial sources. Yet we have scarcely begun to scratch the surface of these “limitless” possibilities. Designers, faced with an extraordinarily rapid turnover of products and a fast, fragmented process of design and construction which has taken root in this electronic age, have yielded the control which they once exercised over the luminous environment to others: to electrical engineers, who have been primarily trained to meet minimum footcandle requirements; to building owners, who come to them with misconceived programmatic objectives; and to misguided government officials, who have been brainwashed by propaganda from the lighting and power industry into adopting and enforcing irrelevant and obstructive codes in the name of progress. This abdication of design responsibility—conscious or unconscious—by the design professions must be reversed. Lacking
an understanding of the basic principles involved, the technicians who now control our luminous environments have reduced the criteria for illumination to simple numbers, which are basically unrelated to vision, perception, comfort, or pleasure.

This blind worship of specific levels of illumination is all too often directly responsible for the defeat and compromise of good designs. If the initial design concept is stated correctly in perceptual terms, so that the type, configuration, and placement of light sources reinforce and facilitate an awareness of information required to satisfy biological needs while providing appropriate qualities of illumination for activity needs, then the actual level of light delivered becomes far less critical. Illumination levels should be a matter of design intent and budget availability and priorities, not merely a response to unjustifiable and often misconceived legal or programmatic requirements. A verbal statement of the design concept as it relates to user needs will be more complete and more likely to produce a good luminous environment than an a priori prescription of numbers. In the design process, determination of the levels of illumination should be the last step—it should be, figuratively, just a question of what size lamp to screw in. Once one understands that the brain analyzes and perceives the entire visual field, and not its individual aspects, the irrelevance of single-parameter numerical criteria such as footcandle levels is immediately apparent.

The reader will note that relatively few references are made in this book to specific quantitative levels of illumination as criteria for the good luminous environment. There are a number of reasons for this conscious omission. Once minimal levels of illumination—on the order of 10 to 15 footcandles—have been achieved, additional light is generally not the most effective means of increasing visibility and visual comfort. In those circumstances where further increasing the quantity of light will produce significant benefits the increase must be substantial, i.e., doubling or quadrupling the original light levels. Absolute luminance levels do have a relationship to sensations of glare and distraction, but it is the patterns of light sources and the nature of their relationship to other elements in the visual field which largely determine the overall quality of the luminous environment. It is the same with the other senses. A few wrong notes makes much more difference to one’s appreciation of a piece of music than the exact volume of sound. The quantity of food one eats at a meal is much less likely to be remembered than a horrible combination of flavors or a single rotten ingredient in an otherwise delectable repast. For analogous reasons, calculation of specific levels of illumination is much less important in lighting design than consideration of the quality of illumination in terms of its distribution and characteristics, the information conveyed by the pattern of the sources, and the degree to which they reinforce or contradict the relationships established by the architecture and the planned activities.

Most modern buildings would provide far superior interior environments for their occupants if they had been consciously designed from the inside out. Today, unfortunately, we find ourselves surrounded by buildings which appear to have been designed primarily from the outside in. The principal intent in formgiving seems to have been the creation of environmental sculpture at the city scale, particularly in the design of working buildings such as offices, schools, libraries, and factories. Except for prestigious lobbies and a
few special or public rooms, the interior luminous environments of
these monuments seem to be almost an afterthought, a low-priority
item in the overall hierarchy of design objectives.

Today our most comfortable, pleasant spaces are those in which
the designers and users retained control over the layout and fine-
tuning of the lighting; spaces such as churches and museums, stores
and restaurants, in which objects of interest are appropriately
emphasized by the luminous environment and set against
backgrounds free from visual noise. The lighting in private homes is
generally satisfactory and pleasant for the same reason—it has usually
been designed and adjusted by the users to suit their specific needs
for visual information, not to achieve some mandatory prescribed light
levels.

All spaces should be designed and lighted to satisfy specific needs,
not just engineered to meet code requirements—different lights, as it
were, for different sites.

In a good luminous environment, that which we want or need to see is
emphasized and highlighted, while that which is not of interest or which
would interfere with our perception of the first class of things is hidden or
played down. It is an unfortunate misconception that there exists a
quantitative gulf between concepts of comfort and pleasure and
concepts of functionality. A comfortable, pleasant luminous
environment automatically satisfies most of the visual needs of its
users, yet we persist in writing specifications for our luminous
environments as if “functional” task lighting were the only objective
to be achieved.

Many perceptive architects have always felt that all was not well,
but most have been unable to describe precisely what is wrong with
the environments they dislike and what is right with the ones they
love. Even those who understand and can specify the qualities which
make for a good luminous environment usually encounter constant
resistance from single-minded engineers, misguided clients, and well-
meaning public officials with whom they must work.

If perception-based lighting design is once again to assume its
proper place as a formgiver for architecture, it will not be because of
the availability of cheaper glass, the introduction of more efficient
light sources, or the generation of more sophisticated computer
programs for calculating light levels. Innovations in each of these
fields, applied indiscriminately, have already made significant
contributions to the pervasive role of lighting as a destroyer of form.
Technology, per se, is powerless to produce a good luminous
environment. Concepts, not hardware, are the missing ingredients in
the conventional approach to the design of the luminous envi-
ronment.

To design good lighting, the designer needs to understand clearly
the principles and processes of visual perception, and the nature of
human needs for visual information.

We do not need more technology, nor do we need more light. What
we do need is an understanding of how to apply the technology
already at our disposal, which can only come from an understanding
of how we see, what we look at, what we perceive, and why. Energy
is no longer the unlimited resource it once appeared to be. The
moment is long overdue when we must change our priorities, and
design buildings which use far fewer resources to far better effect. We
can no longer afford to waste space and energy so lavishly to produce

3 When Life Magazine ran this picture, their caption read: “WHAT A WONDER!
WHAT A BLUNDER! Somewhere there’s a ball up there . . . Sure there is, but we
can’t see it either.”

1 Visual noise refers to distracting visual stimuli (such as oncoming headlights at
night) which interfere with one’s ability to perceive or interpret other more desirable or
needed stimuli which are relevant to the satisfaction of one’s needs. The acoustic
equivalent might be a foghorn in a concert hall. But distractions need not be
overpowering—a neighboring and persistent popcorn-muncher in the same concert hall
might be even more annoying than one blast of a foghorn, however loud, and the same
principle applies to visual noise.
such pitiful, pitiless environments.

The reader may object to the accusation that we spend our resources today as if we had no notion of what people look at, how they see, what they perceive, and how their perceptions influence their emotional state. Yet consider, for example, the colossal fiasco at the Houston Astrodome several years ago (Figs. 3 and 4). Millions of dollars were spent to cover the new Houston stadium with a vast roof, a triumph of structural engineering. As soon as the first game was played, however, one critical problem became apparent.

The players were unable to see the ball against the striking patterns of black and white formed by the structure of the great roof silhouetted against the sky.

Illumination levels were high, almost as high as they were outdoors, yet the players could neither see nor catch the ball. The designers of the Astrodome had apparently never considered the fact that the powerful patterns of the silhouetted roof would make it impossible to pick out the position and trajectory of a ball in flight. The resulting signal-to-noise ratio was so low in the Astrodome that the noble game of baseball was reduced to a comedy of errors.

Since the power of the signal could not be increased (assuming that luminous baseballs remain out of fashion) the only thing that could be done was to reduce the power of the background noise. To correct the situation, the acres of expensive translucent plastic skylights were painted out. The grass died, and was replaced with Astroturf. The artificial lights must now be used for every game.

Unable to think of the requisite luminous environment in terms of quality rather than quantity, many people rationalized that since the skylights had to be painted out at Houston, there must have been too much light. That seems like an eminently reasonable argument, until one considers that the game has been played outdoors under even higher levels of illumination ever since its invention, and baseball players have always been able to see a fly ball silhouetted against the featureless vault of the sky. Had the critics and designers of the Astrodome been thinking in terms of information transfer (too much competing pattern) rather than quantity of sensation (too much light), they would have realized that a structure with less inherent pattern, such as an air-inflated bubble (Fig. 5) of the same dimensions as the original dome, could have been equally bright without interfering in the least with perception of the ball in flight. It is this kind of unclear thinking which we must all learn to avoid. If the problems to be solved in the design of an appropriate luminous environment for the game of baseball had been correctly stated in perceptual terms from the inception of the design process, it is unlikely that the Astrodome would have had such a nasty surprise in store for its owners and designers.

If the perception process, the nature of people’s needs for visual information, and the characteristics of a good luminous environment are clearly understood, the need for new design criteria and a new design process becomes equally clear. Hopefully, “lighting design” will eventually cease to exist as a separate discipline. The current state of affairs bears mute witness to the alienation of one of the architect’s most useful and potent design tools. The design of human environments is, in effect, the design of human sensory experience; all visual design is de facto also lighting design, and the sooner this is acknowledged in the design process, the better.